Briefing Note

Sustainable Soil Management

Background

Soils are in many respects a key resource. They are the source of human, animal and plant life, and thus represent one of the foundations of biodiversity. They have the capacity to store, buffer, filter and transform a large variety of substances, thereby helping to regulate the cycle of matter and conserve and regenerate groundwater. In terms of climate, they are also a major source and sink of carbon. Soils are vital to humans, particularly for producing food and non-food agricultural products.

Because soil formation is an extremely slow process, soils should be viewed as a largely non-renewable and non-multipliable resource. They are coming under ever-increasing pressure from global population growth and the need for additional food and resources which this entails. Overuse (soil mining) and misuse lead to nutrient depletion, erosion and other forms of degradation, which can trigger desertification in dryland areas. Worldwide, a land area equivalent to twice the size of Belgium (6 million ha) becomes degraded each year. This results in the partially irreversible destruction of ecosystems and a decline in yields, with significant consequences for food security and economic development. Some fertile areas, too, are lost through the unabated use of land for housing and industry.

Climate change will also have an increasing impact on soil fertility and erosion in the future. Changes in temperature and water balance will intensify the pressure on soils. The soil itself can contribute to climate change: land-use change and regular upheaval (ploughing for instance) enhance the release of greenhouse gases.

According to the Intergovernmental Panel on Climate Change (IPCC), the increasing frequency of extreme weather events such as drought and heavy rainfall will have accelerate soil degradation and erosion. The World Bank estimates that in sub-Saharan Africa the area affected by severe climate-related soil problems will increase from 9 per cent today to 20 per cent by 2080.

The human race is thus faced with the challenge of increasing soil productivity despite the deteriorating climatic conditions. If the world is to have enough food to eat, yields will need to rise by 40 per cent by 2025.

There is international consensus that we must react to the anticipated changes by intensifying agriculture and land use in a sustainable manner. At the same time we must protect the soil from degradation. However, opinions differ as to how soil productivity can be increased most effectively and sustainably. For example, many non-governmental organisations (NGOs) advocate the promotion of organic smallholder farming systems and low-external-input sustainable agriculture (e.g. Misereor, Brot für die Welt, Oxfam). In contrast, other organisations (e.g. Rockefeller, World Bank, Alliance for a Green Revolution in Africa – AGRA, International Center for Soil Fertility and Agricultural Development – IFDC) support the increased use of inorganic fertil-

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isers and more efficient soil use with the aid of seed that has been improved by breeding or genetic modification and of plant protection products. Many organisations (Food and Agriculture Organization – FAO, AGRA, NGOs) are committed to the principle of conservation agriculture (no/minimum tillage), to reduce erosion and to increase or at least maintain both soil fertility and – in the face of climate change – the carbon content of soil.

International debate is turning increased attention to the significance of soil as a carbon sink. After the oceans, soils are already the world's greatest reservoirs of carbon, storing 1,500 gigatonnes. National and international organisations (e.g. Center for International Forestry Research – CIFOR, FAO, some universities) are currently exploring the use of biochar as an additional carbon reservoir in the soil – one which at the same time increases soil fertility. New methods are being tested in an effort to improve water retention, involving for example the use of hydrogels (polyacrylates neutralised with a solution of caustic soda or potash) which are capable of storing water in the soil for long periods.

GIZ's position

Soils are the foundation of global food security and they are an important source of income, especially in the agrarian economies of many developing countries. Thus they are the basis of economic development, in rural areas in particular. Soils in the vulnerable ecosystems of many developing countries are also severely threatened by unadapted cultivation systems. The consequences of soil degradation are hunger and poverty, which in turn can lead to migration. At the same time incidences of 'land grabbing' (sometimes by international corporations) and conflict over diminishing land resources are increasing.

With this in mind, the aim must be to increase long-term soil productivity and to conserve or expand the area of land usable for agriculture. The focus of GIZ's work must therefore be on developing and expanding sustainable land management. Central issues are erosion, nutrient depletion, the loss of organic matter and salination. Acidification, contamination, compaction, sealing and landslips are other problem areas. Regional focal points are sub-Saharan Africa, India, Central Asia and other semi-arid regions in developing countries. The following approaches are being pursued by GIZ:

1. **Soil mining and desertification must be minimised or stopped, partly through the use of financial incentives.**

Soil protection is a basic requirement for the maintenance of soil fertility and one which must be addressed before rather than after serious damage has been done. It demands good agricultural practices which improve the soil structure, replace removed nutrients and organic substances and improve its water and nutrient use efficiency. An integrated nutrient management system maintaining as closed a nutrient cycle as possible (nutrient recycling) and a post-harvest residue management strategy are called for. State incentives have been shown to promote sustainable land use in cases where it is otherwise uneconomic for individual farms.

Given the importance of soil, processes of soil rehabilitation and recovery should be implemented where degradation has already occurred, if these are economically viable. Erosion protection measures should be planned and carried out – preferably at water basin level – with the active participation of the population concerned (collaboration between financial and technical cooperation). More complex measures must include management and maintenance plans in order to ensure sustainability.

2. **Tillage must be reduced and climate-damaging land-use changes minimised.**

The type and frequency of tillage influence the release of greenhouse gases from soil. Tillage should be minimised to increase its humus– and thus carbon – content and prevent erosion. The 'direct seeding' system developed in Brazil by GIZ in the 1980s works well here. At the same time the development of new technologies aimed at binding carbon – such as biochar – should be followed and assessed with regard to sustainability and relevance to poverty reduction. No more forest/grazing land should be converted to arable land.

3. **Fertilisers must be used correctly.**

Low-external-input sustainable agriculture is in many cases not enough to increase soil fertility. As a basic principle nutrient recycling and organic fertilisers should be favoured over mineral fertilisers; however, nutrient-poor soils require additional input of nutrients. Africa in particular, with its very low rates of mineral fertiliser use, has some catching up to do. So-called 'smart subsidies' for fertilisers can contribute to higher yields and poverty reduction (see Briefing Note: 'Subsidising Agricultural Inputs'). It is important to use fertilisers correctly for the location concerned, and to consider efficiency factors when selecting crops.

4. **The use of adapted agricultural technology must be intensified, irrigation technology optimised.**

More efficient use of land requires not only fertilisers, plant protection products and improved seed, but also greater mechanisation. However, mechanisation should not lead to soil compaction and should be adapted to the economic conditions in developing countries. Light-weight machines and equipment are therefore to be preferred. Where there are erosion and salination problems in particular, but also to increase water-use efficiency in general, soil and water resources need to be considered together (see Briefing Note: 'Effective Agricultural Water Management'). Irrigation measures should not increase the risk of salination.

5. **Land governance must be improved and land consumption reduced.**

Sustainable land use and investment in soil fertility require planning certainty, which in turn requires land rights. At national level measures must be taken to control land consumption and improve land-use planning.

Action required

1. The importance of soil to food security demands that all future activities must give priority to soil protection and the maintenance of soil fertility. To effectively counteract soil erosion and increase soil fertility on a sustainable basis, **internationally binding rules** should be pursued, e.g. in the form of an international soil convention as suggested by the German Advisory Council on Global Change (WBGU) in 1994 and drafted in the context of the international conference on sustainable soil use in 1998.

2. **Legal and economic conditions** also need improvement at national level. Many nations have already set up environmental and even soil protection legislation. Partner nations should be supported in their efforts to introduce and implement such legislation. In cases where sustainable land use does not result in increased income, financial incentive systems should be considered in the form of payment for environmental services (PES).

3. To increase soil productivity in the face of the growing need for food and resources, and at the same time improve resource conservation, production systems in developing countries must become more sustainable. This calls for **sustainability standards** which are oriented towards the particular location and are based on simple types of economic analysis, such as soil sample tests (see Briefing Note: 'Social and Ecological Standards').

4. In tropical and sub-tropical regions in particular, soils are often nutrient-poor and acidified. This calls for the promotion of **a combination of both organic and inorganic fertilisers** (see Briefing Note: 'Assured Agricultural Fertiliser Inputs'). Farmers must receive relevant training and an appropriate business environment must be established. Land-use efficiency in general should be improved, to minimise the need for expansion and decrease the pressure on marginal areas. In addition to fertilisers, this calls for improved seed, more effective plant protection, adapted mechanisation, etc.

5. **Land take (e.g. for housing, roads) should be reduced**, as it takes a very long time to regenerate lost land. At the same time degraded soils should be rehabilitated and put to use.

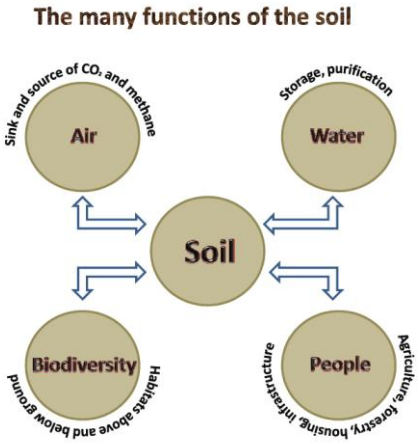
6. Soil plays an important role in reducing greenhouse gas emissions and adapting to climate change. It is potentially capable of binding 5-15 per cent of the annual global carbon emissions from fossil fuels. **Practices which increase the amount of carbon in the soil should be promoted.** These include conservation agriculture and organic farming.

7. **National and international research into soil protection, fertility and the relationship between soil and climate change should be stepped up.** Soil scientists from different fields of study should work together to prevent the increasing intensification of agriculture from having a negative impact on the environment. This task should be demand-oriented, for example by involving land users in technology development and research (farmer innovators).

8. **Digital soil maps**, which are becoming ever more precise through the use of remote sensing, should be developed and utilised to identify at-risk regions and regularly monitor regions which are already degraded. Climatic and ecological differences in the various regions can thus be better taken into account. Changes caused by climate change can also be detected sooner.

9. It is important to scale up successful approaches. **Documenting successful practices and setting up regional and international information and communication platforms** such as the World Overview of

Conservation Approaches and Technologies (WOCAT) and Land Degradation Assessment in Drylands (LADA) can be very helpful in this respect. Such efforts need greater support in order to become more effective.



Source: Steiner, K. GIZ.

Contact

Alexander Schöning
E Alexander.Schoening@giz.de
T +49 6196 79-2076
I www.giz.de

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Deutsche Gesellschaft für
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Responsible: Albert Engel

Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Germany
T +49 61 96 79-0
F +49 61 96 79-11 15
E info@giz.de
I www.giz.de

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